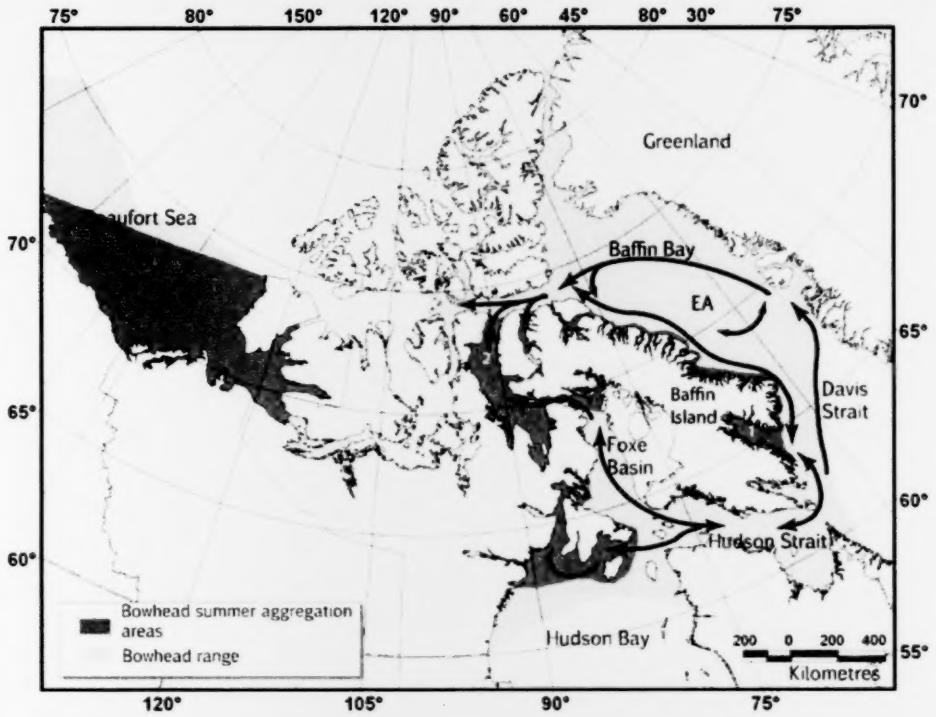


*Figure 2. Map depicting the range of Bowhead Whales in the western and eastern Canadian Arctic, and illustrating the generalized migration routes for the eastern Arctic population. From the wintering areas in the vicinity of Hudson Strait, Cumberland Sound (1) and Davis Strait, whales move toward Greenland, toward northwest Hudson Bay and northern Foxe Basin, and north along the east coast of Baffin Island. From west Greenland, whales continue to spring season areas in northwest Baffin Bay. From northern Foxe Basin whales move into the "nursery" summering area of Prince Regent Inlet and Gulf of Boothia (2). From northwest Baffin Bay some whales continue into the archipelago while others turn southward along the east coast of Baffin Island.*

Killer Whales and protection from predation while overwintering, calving and calf rearing, and foraging. Complex coastal areas, characterized by fjords and bays, offer Bowhead habitat that provides calm shallow waters suitable for young animals with limited diving capabilities and social interaction for adults as well as providing suitable cover from Killer Whale predation in the absence of ice. Cumberland Sound and Frobisher Bay, off southeast Baffin Island (identified as concentration areas in Figure 1), may be used, at least seasonally, for this purpose. Complex landscape areas likely also provide many physical features that enhance opportunities for intensive foraging, as illustrated by the well documented behaviour of Bowheads feeding in troughs during fall in Isabella Bay (mid-eastern Baffin Island).

Bowhead Whales travel great distances, occupy expansive home ranges, and use different habitat features at different times of the year. Two categories of threats to Bowhead habitat were considered. First, the ongoing effects of global warming on loss of sea ice thickness, extent, and duration is likely to impact Bowhead migration routes, travel corridors, and use of sea ice associated with feeding areas and refuge from predation. Second, a longer open-water season will allow for increased use of the Arctic for exploration, development, tourism, human habitation, and travel and will result in greater ship traffic and associated anthropogenic noise. Change or loss of habitat could change patterns of migration, resulting in higher energy costs, increased risk of predation, or lack of access to areas critical to life processes such as calf

rearing and feeding. Climate change is likely to alter the quantity and quality of particular habitats and have negative effects on eastern Arctic Bowhead population viability through changes in calving, migration, feeding, and use of over-wintering range.

## CONCLUSIONS AND ADVICE

In summary, the review of Bowhead habitat identified that influential habitat features may include the presence of suitable ice cover to reduce predation; bathymetry or bottom slope for nursery functions; oceanographic features that concentrate prey (e.g., troughs, upwellings, eddies, funneling ocean currents and water mass boundaries); and complex coastal areas that provide cover from predation, calm waters and enhanced opportunities for intensive foraging.

The results of this review also identified the following habitat features and current use areas: (1) overwintering habitat in Hudson Strait and Davis Strait associated with avoidance of risk of ice entrapment and Killer Whale predation; (2) the northern Foxe Basin calving area associated with habitat used to shelter neonates and juveniles; (3) the Gulf of Boothia-Prince Regent Inlet region associated with nursing female Bowhead accompanied by calves; and (4) the mid-eastern coastline waters of Baffin Bay where consistent major feeding occurs (see Figure 1).

## OTHER CONSIDERATIONS

Bowhead Whale life-history characteristics include long life (up to 200 years), long birth interval (3 to 4 years), and long generation times (greater than 20 years). Bowhead Whales occur at relatively low density over their vast range and are under water for long dives to access food making them less available for sightings and therefore difficult to evaluate total numbers or change in numbers over time. As with many marine mammals, population size and trend is difficult to assess accurately for Bowhead Whales. Thus, it will take a relatively long time to detect impacts of loss of critical habitat in terms of changes in population size. While Bowhead Whales may be well adapted to surviving short periods (weeks or months) of low energy acquisition, long-term changes in habitat loss, access to preferred habitat, or increased vulnerability to predation, may result in increases in mortality that could go largely undetected and could threaten the survival of the population.

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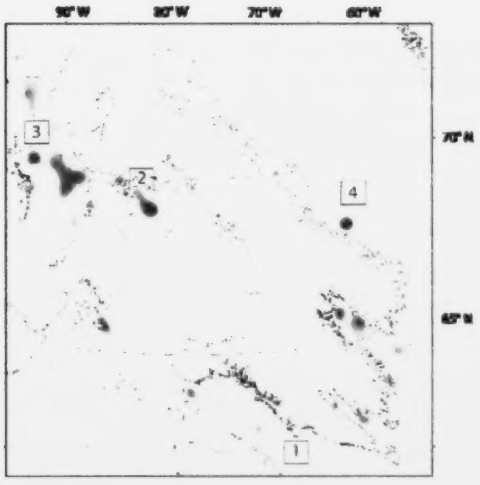
Science | Sciences
Central and Arctic Region
Canadian Science Advisory Secretariat
Science Advisory Report 2008/060

# ADVICE RELEVANT TO IDENTIFICATION OF EASTERN CANADIAN ARCTIC BOWHEAD (*BALAENA MYSTICETUS*) CRITICAL HABITAT

*Jeff Higdon*




**Context:**

*In 2005, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessed and designated the two Eastern Arctic Bowhead Whale (*Balaena mysticetus*) populations in the Canadian Eastern Arctic as Threatened. After a species is listed under the* Species At Risk Act *(SARA) then a recovery strategy must be developed. The Act requires that critical habitat be identified in the strategy to the extent possible based on the best information available or that a schedule of studies be included that, when completed, would allow critical habitat to be identified. In anticipation of possible listing, an Eastern Arctic Bowhead Recovery Team was formed in winter 2006 to develop a recovery strategy. In 2008, a Recovery Potential Assessment report was published for the Eastern Arctic Bowhead population (DFO 2008) which did not include information on habitat. The Team requested advice from DFO Science on habitat features critical for the survival or recovery of Bowhead Whales and the geographical availability of habitats that contain those features. If the information currently available is inadequate, then DFO Science has been asked to describe a plan of research studies necessary to complete the knowledge gaps.*

*This report is an addendum to the 2008 Recovery Potential Assessment (DFO 2008).*

*Figure 1: Temporal concentrations of Bowhead Whale use in the eastern Canadian Arctic derived from satellite telemetry locations of 14 Bowheads tagged in northern Foxe Basin (July 2002 and 2003) and in Cumberland Sound (May 2004 and July 2005-2006). Darker colour indicates greater time spent in the area. Important Bowhead habitat includes Hudson Strait [1], northern Foxe Basin [2], Gulf of Boothia and Prince Regent Inlet [3], the coastal waters off eastern Baffin Island [4]. This map likely represents an incomplete assessment of potentially important habitat for this population as variations in habitat use may occur among animals and years, and it does not include data for whales tagged in Greenland.*

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## SUMMARY

Known Bowhead distribution patterns suggest that influential habitat features may include the following:

- presence of suitable ice cover to reduce predation;
- proximity to shallow bathymetry or bottom slope for nursery functions;
- oceanographic features that concentrate prey (e.g., troughs, upwellings, eddies, funneling ocean currents, and water mass boundaries); and
- complex coastal areas that provide cover from predation, calm waters, and enhanced opportunities for intensive foraging.

The Eastern Arctic Bowhead Recovery Team should consider the following habitat processes and current use areas (Figure 1) in its assessment of critical habitat:

- overwintering habitat in Hudson Strait and Davis Strait associated with avoidance of risk of ice entrapment and Killer Whale (*Orcinus orca*) predation (from about late December to late March);
- the northern Foxe Basin calving area associated with habitat used to nurture and shelter neonates and juveniles (from about late May to late July);
- the Gulf of Boothia-Prince Regent Inlet region associated with nursing female Bowheads accompanied by calves (from about late July to October); and
- the mid-eastern coastline waters of Baffin Island where consistent late autumn feeding occurs (from about mid-July to late October).

## BACKGROUND

The current range of the Eastern Canada-West Greenland population of Bowhead Whales includes the coastal waters and major fiords of Nunavut and West Greenland. Historically, the range included the coastal areas of Labrador and the Strait of Belle Isle. The population is estimated to have numbered 12,300 prior to commercial whaling (Woodby and Botkin 1993). Bowhead Whales in eastern Arctic were designated as Threatened by COSEWIC in May 2005 (COSEWIC 2005). The primary reason for the historic collapse and Threatened designation of this population was an intensive commercial harvest which took place primarily during the 19$^{th}$ century.

## ANALYSIS

Bowhead Whales do not have any known dwelling-place similar to a den or nest during any part of their life cycle; hence the concept of "residence" as defined in the Species at Risk Act does not apply.

Relevant information available regarding Bowhead habitat was reviewed. Features that characterize Bowhead habitat are described briefly, and to the extent possible, the quantity and quality of habitat used by Bowheads, the biological functions served by different habitats, and existing or potential threats to habitat or access to habitat were evaluated. Bowhead Whale habitat use and possible functions of habitats selected seasonally in the eastern Canadian Arctic was evaluated using utilization distributions of telemetry results for 2002-2006. Research

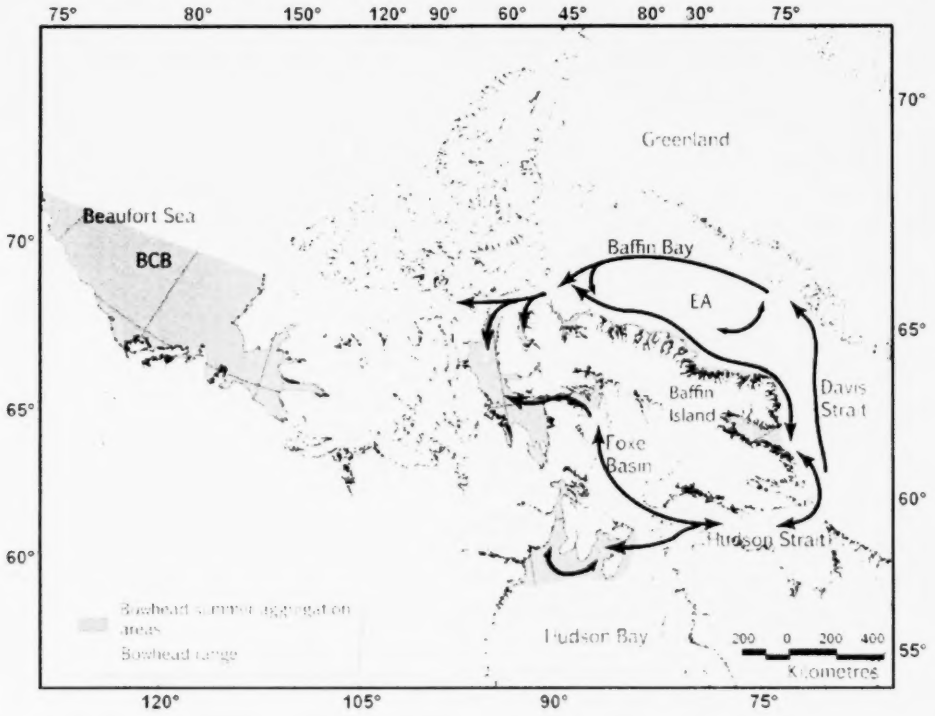
necessary to provide the information on habitat relationships and required to properly identify "critical" habitat for eastern Arctic Bowhead Whales was discussed.

The distribution and migrations of Bowheads in the eastern Canadian Arctic are closely linked with the seasonal changes in sea ice (Figure 2). From wintering areas in Hudson Strait and the pack ice of Davis Strait, Bowheads move north by several routes following the receding ice into the Arctic Archipelago to spring and then summering areas along the west coast of Baffin Island. In early spring, a segment of the Bowhead population leaves the overwintering area and migrates north along the western coast of Greenland to Disko Bay, then either west across Baffin Bay to the east coast of Baffin Island or north to the expanding southern margin of the North Water polynya. Another route from the overwintering area brings whales north along the east coast of Baffin Island and a third route used by another segment of the population moves west through Hudson Strait to polynyas in northwestern Hudson Bay and northern Foxe Basin. Nursery areas, such as northern Foxe Basin, are characterized by shallow waters and ice cover, providing safe and relatively calm waters with simple predictable oceanographic processes suitable for nursing newborns during spring and early summer. As winter sea ice progressively diminishes, segments of the Bowhead population in the regions of northern Foxe Basin and Lancaster Sound continue to move further into the archipelago while the third segment of the population moves along the coast of eastern Baffin Island. Fall migrations southward occur (1) along the east Baffin Island coast and (2) through Fury and Hecla Strait and Foxe Basin, bringing whales once again to wintering areas in the vicinity of Hudson and Davis Straits.

Two key biological features that define the characteristics of Bowhead Whale habitat were considered: (1) energy acquisition related to reproduction and survival and (2) avoidance of direct mortality by selecting habitat that reduces risk of ice entrapment and predation by Killer Whales. Specific habitat requirements differ between sex/age/reproductive classes, as suggested by the observed population segregation. Known Bowhead distribution patterns suggest that influential habitat features may include one or more of the following: ice characteristics such as concentration, age or thickness, and floe size; bathymetry or bottom slope; oceanographic features that concentrate prey such as troughs, upwellings, eddies, funneling ocean currents, and water mass boundaries; and landscape patterns that provide cover from Killer Whales or reduce the likelihood of Killer Whale occurrence.

Bowhead alternate foraging behaviour between (1) obtaining a significant proportion of their annual energy requirements by feeding intensively in areas of concentrated prey during relatively brief but predictable seasonal periods, (2) foraging opportunistically during migration or other times for hours or several days, and (3) fasting for extended periods (Lowry 1993). Habitat features that provide seasonal concentrated sources of zooplankton are thus most likely important features that define critical habitat for Bowhead Whales from spring to fall periods. The early spring polynyas that are exploited by Bowheads are reasonably predictable and presumably important in Bowhead foraging ecology. The autumn use of Isabella Bay, eastern Baffin Island, is also clearly documented as an important habitat of recurring use. However, the location and extent of important habitat in other areas or times of the year is more difficult to identify in specific geographic terms.

Killer Whales in the Canadian Arctic sometimes hunt along ice edges and leads but typically avoid heavy ice concentrations, presumably because of potential damage to their dorsal fin or due to a behavioural tradition. In contrast, Bowheads lack a dorsal fin and are capable of breaking thick ice; thus, for Bowheads the presence of suitable ice cover provides exclusion of

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Bowhead Whales travel great distances, occupy expansive home ranges, and use different habitat features at different times of the year. Two categories of threats to Bowhead habitat were considered. First, the ongoing effects of global warming on loss of sea ice thickness, extent, and duration is likely to impact Bowhead migration routes, travel corridors, and use of sea ice associated with feeding areas and refuge from predation. Second, a longer open-water season will allow for increased use of the Arctic for exploration, development, tourism, human habitation, and travel and will result in greater ship traffic and associated anthropogenic noise. Change or loss of habitat could change patterns of migration, resulting in higher energy costs, increased risk of predation, or lack of access to areas critical to life processes such as calf

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